

LASERS

1. The "laser" is an amplifier or oscillator which operates by induced emission utilizing light waves. The term laser stands for "light amplification by stimulated emission of radiation". Terminology such as "maser" and "iraser" refer to amplification of micro-waves and infra-red waves respectively.

2. Amplification techniques are based on the fact that atoms and molecules exist in certain energy levels or states. For an isolated atom to alter its state it must absorb a photon or emit a photon. Thus, a laser is constructed so that an excess of atoms can be maintained in the upper energy state in the material. When a light wave of the proper frequency strikes one of these excited atoms, the atom is forced to emit radiation of the same frequency giving up its excitation energy in the process. As the wave continues in the laser it continues to grow or is amplified as it continues to strike the excited atoms.

3. The output of a laser is inherently very directional, nearly monochromatic, and almost coherent. It permits, by the use of lens or mirrors, focusing the entire output to a spot a little larger than the wavelength of light (about one-billionth of an inch). This means that with a power output of only a few milliwatts the power density in the focal spot would then be some millions of watts per square inch. These characteristics suggest general uses even though the specific use is dependent on the characteristics of the individual device. Possible uses are:

- a. Communications - of all types including space and plasma penetration during reentry.
- b. Optical Radar - surveillance, tracking rangefinder, air to ground.
- c. Weapons - sensor destruction, anti-vehicle, anti-personnel, anti-missile.
- d. Miscellaneous - spectroscopy, power transmission, microphotography, power transmission, light source, fabrication techniques (welding, cutting, etc), weapons simulation.

4. Much of the research and development going on in this field is in materials and techniques although there are numerous studies under way relative to applications. There are many difficulties to overcome before "amplification by stimulated emission of radiation" becomes practical in all of the anticipated use. However, certain applications have been determined to be feasible in the laboratory. CIA has several studies for communications and photographic applications.